The lanternfly genus *Aphaena* Guérin-Méneville (Hemiptera: Fulgoridae) in China

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Abstract: The lanternfly genus *Aphaena* Guérin-Méneville in China is reviewed. One species and one subspecies are reported for the first time from China. *Aphaena decolora* Chou *et* Wang is redescribed based on the holotype. A key to all species of this genus in China is provided.

Key words: Auchenorrhyncha; Fulgoroidea; taxonomy; key

中国梵蜡蝉属分类研究（半翅目：蜡蝉科）

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摘要：研究了中国梵蜡蝉属 *Aphaena* Guérin-Méneville 的种类，报道了采自中国南方的 1 新纪录种及 1 新纪录亚种，提供了中国该属的分种检索表。

关键词：头喙亚目；蜡蝉总科；分类；检索表

Introduction

The genus *Aphaena* belongs to Aphaenini within the subfamily Aphaeninae. It was established by Guérin-Méneville (1834) with *Aphaena discolor* Guérin-Méneville (1834) as its type species. This genus is characterized by the cephalic process very slender, acute, reflexed or erect; pronotum almost twice as broad as vertex, with a deeply impressed point at each side of median carina; metatibiae with 4–6 lateral spines (Guérin-Méneville 1834; Atkinson 1885; Distant 1906; Lallemand 1963). Currently, it is represented by 2 subgenera, 15 species and 4 subspecies in the world (Bourgoin 2019). It is widely distributed in south China, India, Bangladesh, Vietnam, Indonesia, Myanmar, Laos and Philippines (Metcalf 1947; Distant 1906; Lallemand 1963; Nagai & Porion 1996; Bourgoin 2019).

The genus *Aphaena* is rich in species in the Chinese fauna, including 4 species, *A.* (*Aphaena*) *aurantia* (Hope), *A.* (*A.*) *decolora* Chou *et* Wang, *A.* (*Callidepsa*) *hainanensis* Wang and *A.* (*C.*) *cornuta* (Fabricius) to date (Chou *et al*. 1984, 1985; Lallemand 1963;

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Metcalf 1947; Nagai & Porion 1996; Xu & Qin 2012). In this paper, one species and one subspecies, *A*. (*C*.) *amabilis* (Hope) and *A*. (*A*.) *discolor nigrotibiata* (Schmidt) are reported for the first time from China, and *A*. *decolora* Chou *et* Wang is redescribed based on the holotype. A key to all known *Aphaena* species in the Chinese fauna is also given.

Material and methods

Dry pinned-and-mounted and pure ethanol-soaked specimens were used for this study. External morphology was observed under a stereoscopic microscope and characters were measured with an ocular micrometer. Genital segments of the examined specimens were macerated in 10% NaOH and drawn from preparations in glycerin using a light microscope, subsequently rinsed several times with pure water and transferred into glycerin. Photographs of the specimens were made using a Leica M205A microscope with Leica DFC Camera. Images were captured and processed using Leica Application Suite (LAS) V3.7 and edited using Adobe Photoshop CS 8.0 (Adobe Systems).

Specimens examined in this study are deposited in the Entomological Museum, Northwest A&F University, Yangling, Shaanxi, China (NWAFU). Body measurements are from apex of vertex to tip of abdomen (female body length not including the extension for mating and spawning). All measurements are in millimeters (mm). The morphological terminology used in this study follows O'Brien (1988) for external morphology, Bourgoin *et al*. (2014) for venation of the forewings and the nomenclature of female genital structures follows Bourgoin (1993).

Taxonomy

Genus *Aphaena* Guérin-Méneville

Aphaena Guérin-Méneville, 1834: 451. Type species: *Aphaena discolor* Guérin-Méneville, 1834.

Aphana Burmeister, 1835: 2, synonymized by Westwood, 1837: 75.

Euphria Stål, 1863: 231, synonymized by Atkinson, 1885: 150.

Based on the descriptions of Guérin-Méneville (1834), Atkinson (1885), Distant (1906), Lallemand (1963) and the examination of specimens in this study, the diagnosis of this genus is modified as follows:

Head (including eyes) much narrower than pronotum (Figs. 1, 4, 7, 16, 18, 29, 31). Vertex about 2.0 times as broad as an eye, lateral margins carinate; cephalic process very slender, acute, reflexed or almost vertical (Figs. 1, 2, 4, 5, 7, 14–16, 18, 20, 28, 29, 31, 33). Frons quadrangular, medially with 2 or 3 longitudinal carinae; clypeus narrower and shorter than frons, labium elongate, with median carina on clypeus (Figs. 3, 6, 8, 17, 19, 30, 32). Pronotum almost twice as broad as vertex, with a deeply impressed point at each side of median carina (Figs. 1, 4, 7, 16, 18, 29, 31). Mesonotum tricarinate, median carina straight, lateral carinae curved, reaching posterior margin (Figs. 1, 4, 7, 16, 18, 29, 31). Tegmina elongate, apical margin broadly rounded, apical venation reticulate (Figs. 1–5, 9, 14–17, 28–30). Hindwings shorter and broader than tegmina, apical cell and clavus venation reticulate (Figs. 1, 3, 4, 6, 15–17, 29, 30). Metatibiae with 4–6 lateral spines.

Male genitalia. Pygofer symmetrical, narrow and subquadrangular in lateral view. Anal tube subtriangular in lateral view, in dorsal view gradually broadened distad, apical margin concave; epiproct and paraproct separated in lateral view, in dorsal view epiproct short and broad, paraproct slender, surpassing end of anal tube (Fig. 12). Genital styles subtriangular or oval in lateral view, submedially with a hook-shaped process near dorsal side (Fig. 13). Phallobasal conjunctival processes inflated at apical third (Fig. 11).

Female genitalia symmetrical in caudal view (Figs. 21, 34). Anal tube gradually broadened distad, apical margin concave, epiproct short, paraproct long and subulate, slightly surpassing end of anal tube in dorsal view (Figs. 21, 27, 34, 39). Endogonocoxal process of urite VIII sclerotized in apical 1/2, anterior connective lamina with four or five teeth at apex, lateral margin of endogonocoxal lobe convex in ventral view (Figs. 21, 22, 23, 34, 35); in urite IX, two gonapophysis IX fused basally and each is reinforced posteriorly by a sclerotized rod, gonospiculum bridge clubbed (Figs. 21, 24, 25, 34, 36, 37), gonoplacs quadrilateral or sub-rotund, bilobed, posteroventral partly membranous and forming a pouch–like structure around four gonapophyses (Figs. 21, 25, 26, 34, 37, 38).

Remarks. Two subgenera in this genus are currently recognized, i.e. *Aphaena* (*Aphaena*) Guérin-Méneville and *Aphaena* (*Callidepsa*) Stål. The differences between them lie in the nominate subgenus having the cephalic process short, reflexed and reaching the pronotum (cephalic process elongate, almost vertical and not reflexed in *Aphaena* (*Callidepsa*) Stål) (Guérin-Méneville 1834; Lallemand 1963).

Distribution. Indomalayan Region. In the Chinese fauna, the known species have been reported only in Hainan and Yunnan Provinces.

Key to the Chinese species of *Aphaena* Guérin-Méneville

1. Cephalic process short, reflexed and reaching pronotum (subgenus *Aphaena* (*Aphaena*)) (Figs. 1, 2, 4, 5, 7, 28, 29, 31, 33)·····2
-. Cephalic process elongate, almost vertical, not reflexed (subgenus *Aphaena* (*Callidepsa*)) (Figs. 14–16, 18, 20)·····4
2. Hindwings with the same colour (pale green) basally and apically (Figs. 1, 3)·····*A.* (*A.*) *aurantia* (Hope)
-. Hindwings with different color basally and apically (Figs. 4, 6, 29, 30)·····3
3. Hindwings black brown basally, orange apically (Figs. 29, 30)·····*A.* (*A.*) *discolor nigrotibiata* (Schmidt)
-. Hindwings white basally, pale green apically (Figs. 4, 6)·····*A.* (*A.*) *decolora* Chou *et* Wang
4. Tegmina sanguineous but black medially·····*A.* (*C.*) *cornuta* (Fabricius)
-. Tegmina of uniform color·····5
5. Tegmina greenish-ochraceous on upper side and pale purplish–red in basal half on ventral side (Figs. 14–17)·····*A.* (*C.*) *amabilis* (Hope)
-. Tegmina orange in basal half on upper and ventral sides·····*A.* (*C.*) *hainanensis* Wang

1. ***Aphaena* (*Aphaena*) *aurantia* (Hope, 1840)** (Figs. 1–3)

Aphana aurantia Hope, 1840: 443.

Aphana aurora Hope, 1843: 133.

Euphria aurora, Stål, 1863: 232.

Euphria aurantia, Distant, 1906: 208.

Aphaena aurantia, Metcalf, 1947: 137; Xu & Qin, 2012: 232.

Body length: ♀ 22.2–22.5 mm; ♂ 19.7–21.5 mm. Wingspan: ♀ 70.5–72.2 mm; ♂

68.7–70.2 mm.

Specimens examined. 2♀2♂, **China,** Yunnan, Menglianan Mountain, 25-V-2011, coll. Silong XU.

Distribution. China (Yunnan); India; Bangladesh.

1 2 3

Figures 1–3. *Aphaena* (*Aphaena*) *aurantia* (Hope). 1. Adult, dorsal view; 2. Adult, left lateral view; 3. Adult, ventral view.

2. ***Aphaena* (*Aphaena*) *decolora* Chou *et* Wang, 1984** (Figs. 4–13)

Aphaena decolora Chou *et* Wang, 1984: 192.

Aphaena decolorata, Chou *et al*., 1984: 107. laps. cal.

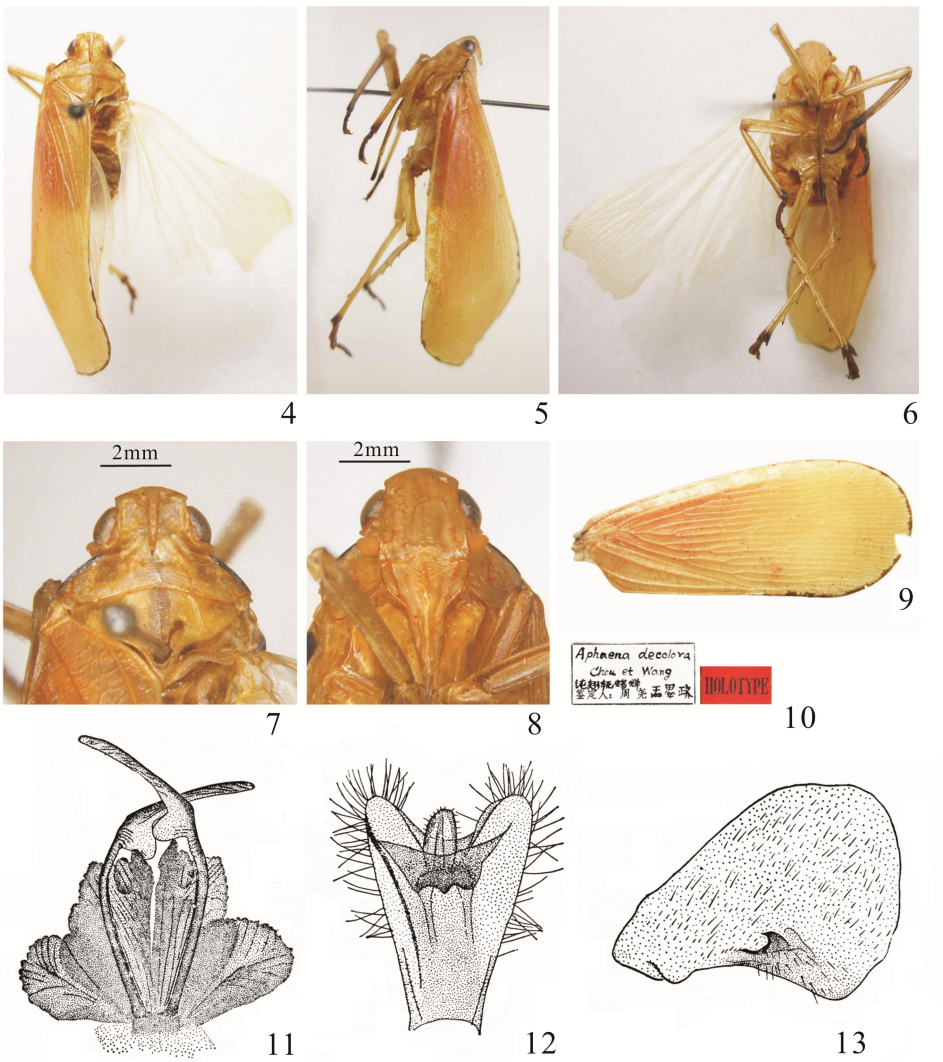
Body length: ♂ 16 mm. Wingspan: ♂ 54 mm.

This species was described by Chou & Wang (1984); the original description of this species is as follows:

Head green, cephalic process slender and reflexed, reaching half of pronotum; vertex quadrangular, two longitudinal median carinae parallel, anterior margin slightly curved, posterior margin slightly concave, lateral margins carinate; clypeus about 2/3 times as long as frons, medially slightly convex, median carina present, lateral margins carinate; labium brown, elongated, reaching third abdominal segment. Eyes brownish and oval. Antennae orange, short. Thorax yellowish green, slightly concave on disc, anterior margin slightly convex medially, laterally black along both lateral margins; mesonotum tricarinate. Abdomen green dorsally, ventrally orange yellow, covered with white wax. Tegmina orange red in basal half, gradually pale orange yellow apically, margin (except clavus) ornamented with narrow black line, costal area with numerous pale patches; vein green, apical margin round. Hindwings whitish at base, partly red, apically pale green, vein pale green. Legs green, tarsomeres brown, metatibiae with 5 lateral spines.

Remarks. Chou *et al.* (1984) and Chou *et al.* (1985) did not describe the male genitalic characters of this species. Although Chou *et al.* (1985) illustrated the anal tube, genital styles and phallic complex (Chou *et al.*, 1985, Figs. a-c, p. 12), the male genitalic characters of this species remain obscure because male genitalia of the holotype has apparently been lost. This study includes the illustrations of Chou *et al.* (1985) (Figs. 11–13) in order to provide complete information on the genus *Aphaena* for readers. However, we believe this species needs to be re-investigated when more material becomes available in future studies.

Chou *et al*. (1984) described *Aphaena decolora* based on a single male from Yunnan, noting that "this species is very similar to *A. aurantia* (Hope), but the body shorter (body length 19–22 mm and wingspan 63–70 mm in *A. aurantia*); tegmina not green, without white spots. Furthermore, these two species can be easy distinguished by the morphological characteristic of pygofer, genital styles and phallic complex of male genitalia". This study finds the head, thorax and abdomen of the holotype yellow-brown; tegmina orange with base orange–red, which shows some differences from the original descriptions.



Figures 4–13. *Aphaena* (*Aphaena*) *decolora* Chou *et* Wang. 4. Adult, dorsal view; 5. Adult, left lateral view; 6. Adult, ventral view; 7. Head and thorax, dorsal view; 8. Face; 9. Tegmina; 10. Labels; 11. Phallic complex (from Chou *et al.*, 1985); 12. Anal tube (from Chou *et al.*, 1985); 13. Genital styles, lateral view (from Chou *et al*., 1985).

After checking the holotype of this species, this species has the cephalic process short, reflexed and reaching the pronotum, it meets the diagnosis of the nominate subgenus of *Aphaena* (Guérin-Méneville 1834; Atkinson 1885; Distant 1906; Lallemand 1963). Hence, we think this species should be placed into the subgenus *Aphaena*.

Specimens examined. 1♂ (holotype), **China,** Yunnan, Changning, Xinchang, 18-VI-1979, coll. Changning team.

Distribution. China (Yunnan).

3. ***Aphaena* (*Callidepsa*) *cornuta* (Fabricius, 1803)**

Lystra cornuta Fabricius, 1803: 57.

Euphria (*Callidepsa*) *cornuta*, Stål, 1869: 87.

Aphaena (*Callidepsa*) *cornuta*, Metcalf, 1947: 142.

Distribution. China.

4. ***Aphaena* (*Callidepsa*) *hainanensis* Wang, 1995**

Aphaena hainanensis Wang, 1995: 99.

Remarks. The original description reveals that this species has the cephalic process elongate, almost vertical and not reflexed (Wang 1995), meeting the diagnosis of this subgenus (Stål 1869; Lallemand 1963). Here we place this species into the subgenus *Aphaena* (*Callidepsa*) Stål.

Distribution. China (Hainan).

5. ***Aphaena* (*Callidepsa*) *amabilis* (Hope, 1843)** (Figs.14–27), new record to China

Aphana amabilis Hope, 1843: 132.

Aphaena amabilis, Walker, 1851: 274.

Euphria amabilis, Stål, 1863: 232.

Aphaena lectissima Walker, 1858: 45

Aphaena (*Aphaena*) *amabilis*, Metcalf, 1947: 136.

Aphaena (*Callidepsa*) *amabilis*, Lallemand, 1963: 42.

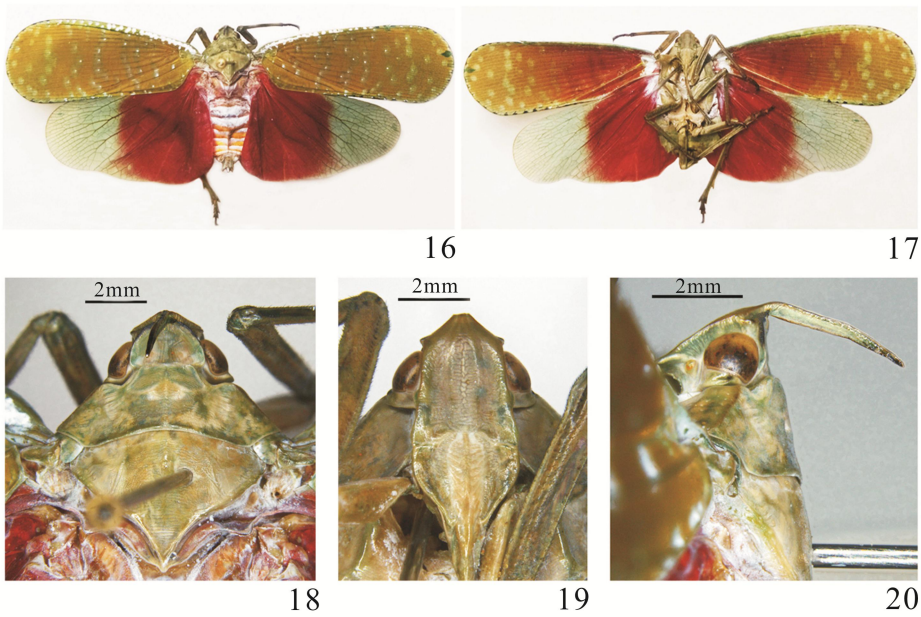
Body length: ♀ 22.1–22.5 mm. Wingspan: ♀ 67.5–68.1 mm.

14 15

Figures 14, 15. Specimens of *Aphaena* (*Callidepsa*) *amabilis* (Hope) in nature. In Hainan, Mt. Wuzhishan, May, 2016 (photographed by Fanmei ZHOU).

The fresh specimens with head, pronotum and mesonotum pale green (Figs. 14, 15). Tegmina yellowish green on the upper side, scattered with numerous oval spots, a compact

row of white spots along costal margin and black spots along apical and costal margin (Figs. 14, 15); on ventral side tegmina pale purplish-red in basal half (Figs. 14, 15). Hindwings bright purplish-red in basal 2/3, remaining area virescent (Fig. 15). Abdominal tergites mostly orange (Fig. 15); sternites and legs green (Figs. 14, 15). The dry specimens are faded in colour (Figs. 16–20). Tegmina becoming sordid yellowish red on upper side (Figs. 16, 17). After soaking in pure ethanol, the tegmina become golden yellow and the hindwings white on apical 1/3.



Figures 16–20. *Aphaena* (*Callidepsa*) *amabilis* (Hope). 16. Adult, dorsal view; 17. Adult, ventral view; 18. Head and thorax, dorsal view; 19. Face; 20. Head and thorax, left lateral view.

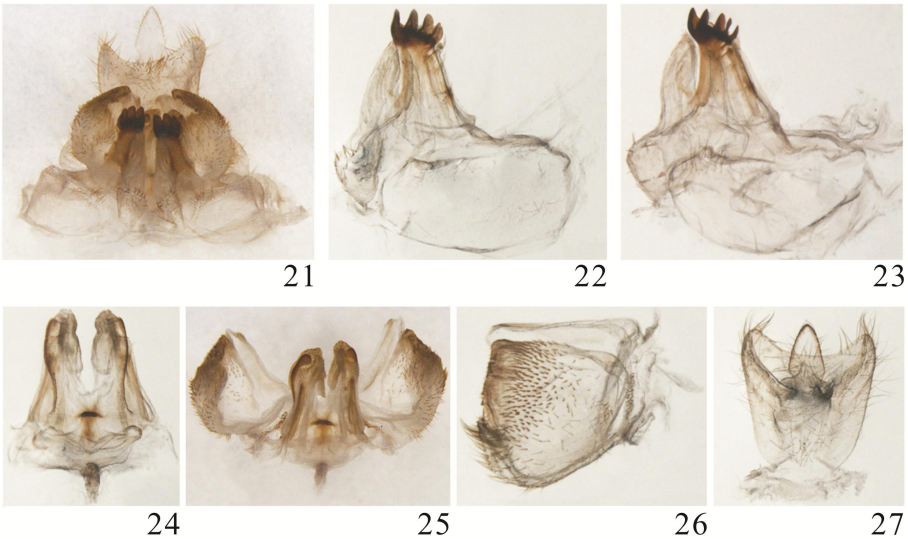
Vertex with cephalic process acute, almost vertical (Figs. 14–16, 18, 20). Frons medially with 2 longitudinal carinae (Figs. 17, 19); labium of clypeus reaching fifth abdominal segment (Figs. 17, 19). Metatibiae with 5 lateral spines and 7 apical spines.

Female genitalia. Anal tube with epiproct short, incisive apically, lateral margin concave (Figs. 21, 27). Endogonocoxal process of urite VIII anterior connective lamina with four teeth at apex (this study found one specimen with five teeth) (Figs. 21–23); in urite IX, gonoplacs quadrilateral, ventral margin oblique, dorsal margin straight in lateral view (Figs. 21, 25, 26).

Remarks. Hope (1843) noted the tegmina of this species with “the spots which on the upper side appear to be white and green intermixed, are beneath entirely green”. This research found the fresh specimens have the tegmina green and intermixed with numerous oval pale greenish spots on the upper side, on the ventral side the tegmina pale purplish-red in basal half; the pure ethanol-soaked specimens have the tegmina sordid yellowish-red on the upper side.

Specimens examined. 8♀, **China,** Hainan, Mt. Wuzhishan, 11-V-2018, coll. Fanmei ZHOU. 1♀, Hainan, Ledong, Mt. Jianfengling, 20-VI-2018, coll. Bin LIU.

Distribution. China (Hainan); Bangladesh; India (Assam, Sikkim); Vietnam (Tonkin).



Figures 21–27. *Aphaena* (*Callidepsa*) *amabilis* (Hope). 21. Female genitalia, caudal view; 22. Urite VIII, ventral view, right side (with four teeth); 23. Urite VIII, ventral view, right side (with five teeth); 24. Gonapophysis IX and gonospiculum bridge, dorsal view; 25. Urite IX, ventral view; 26. Gonoplac, lateral view, right side; 27. Anal tube, dorsal view.

6. ***Aphaena* (*Aphaena*) *discolor nigrotibiata* (Schmidt, 1906)** (Figs. 28–39), new record to China

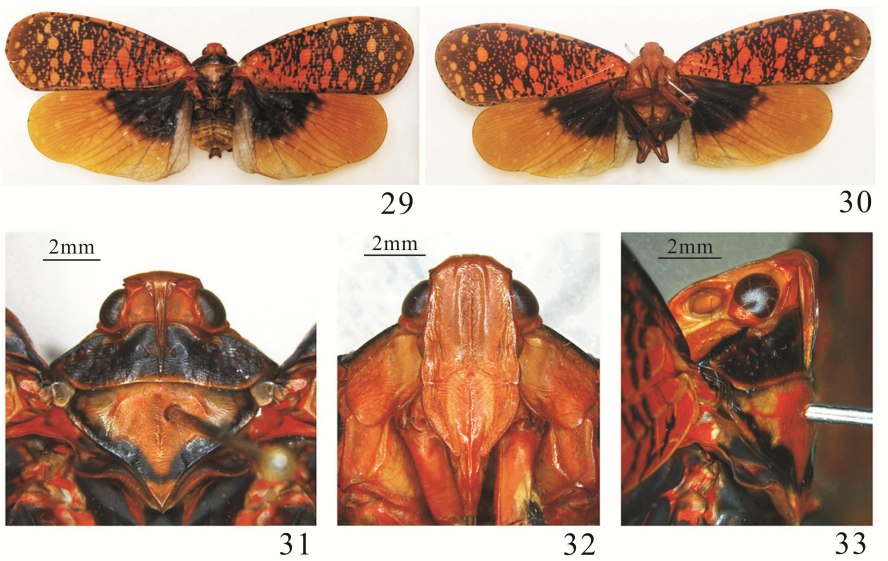
Euphria nigrotibiata Schmidt, 1906: 189.
Aphaena (*Aphaena*) *nigrotibiata*, Metcalf, 1947: 140.
Aphaena (*Aphaena*) *discolor nigrotibiata*, Lallemand, 1963: 40.
Aphaena vicina Lallemand, 1956: 6.
Aphaena (*Aphaena*) *discolor nigrotibiata*, Nagai & Porion, 1996: 18.

Body length: ♀ 22.1–23.1 mm. Wingspan: ♀ 74.1–74.6 mm.

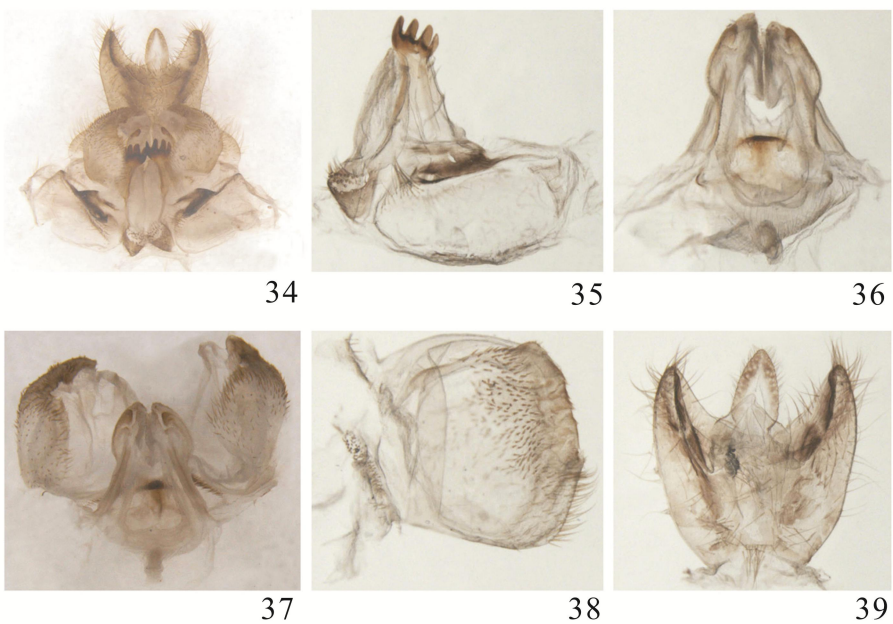
Figure 28. Specimens of *Aphaena* (*Aphaena*) *discolor nigrotibiata* (Schmidt) in nature. In Hainan, Mt. Wuzhishan, May, 2016 (photographed by Fanmei ZHOU).

Head orange red (Figs. 29, 31). Pronotum black, lateral and posterior margins reddish orange (Figs. 29, 31). Mesonotum reddish orange, with black stripes along posterior margin (Figs. 29, 31). Tegmina basal and apical costal area reddish orange; a row of black spots along costal area, apical margin and posterior margin; remaining area of tegmina black with numerous sub-rotund, irregular and variable sized reddish orange brindles (Figs. 28–30). Hindwings with clavus hyaline, basal 2/3 black brown, remaining area orange, with numerous oval pale spots (Figs. 29, 30). Abdomen black anteriorly on each tergite, posterior segments orange; sternites orange (Fig. 29, 30). Legs orange with pro-, mesotibia, tarsomeres black, metatarsomeres

black (Figs. 28, 30).



Figures 29–33. *Aphaena* (*Aphaena*) *discolor nigrotibiata* (Schmidt). 29. Adult, dorsal view; 30. Adult, ventral view; 31. Head and thorax, dorsal view; 32. Face; 33. Head and thorax, left lateral view.



Figures 34–39. *Aphaena* (*Aphaena*) *discolor nigrotibiata* (Schmidt). 34. Female genitalia, caudal view; 35. Urite VIII, ventral view, right side; 36. Gonapophysis IX and gonospiculum bridge, dorsal view; 37. Urite IX, ventral view; 38. Gonoplac, lateral view, left side; 39. Anal tube, dorsal view.

Vertex with cephalic process acute, reflexed, reaching pronotum (Figs. 28, 29, 31, 33). Frons medially with 2 longitudinal carinae; labium of clypeus reaching fifth abdominal segment (Figs. 30, 32). Lateral and posterior margins of pronotum carinate (Figs. 29, 31). Metatibiae with 5 lateral and 7 apical spines.

Female genitalia. Anal tube with epiproct short and acutely angled apically (Figs. 34, 39). Endogonocoxal process of urite VIII anterior connective lamina with four teeth at apex (Figs. 34, 35). In urite IX, the gonoplacs sub-rotund, ventral margin oblique, dorsal margin rounded in lateral view (Figs. 34, 37, 38).

Specimens examined. 1♀, **China,** Hainan, Ledong, Mt. Jianfengling, 17-VIII-1982, coll. Peizhen CHEN. 6♀, Hainan, Mt. Wuzhishan, 11-V-2018, coll. Fanmei ZHOU. 1♀, Hainan, Ledong, Mt. Jianfengling, 20-VI-2018, coll. Bin LIU.

Distribution. China (Hainan); Vietnam.

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